FETC Conference
Formation, Distribution, Impact and Fate of
Sulfur Trioxide in Utility Flue Gas Streams

Fate of Sulfur in Utility Boilers With SCR

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Abstract

NOx control legislation calls for significant NOx reductions from utility boilers over the next five years. An estimated 100,000 MW of generating capacity will be affected by this legislation and be required to reduce NOx. Of this capacity, 30 to 50% is expected to require post-combustion NOx control in the form of urea and ammonia-based SCR and SNCR. The high sulfur content of coals and fuel oils used in utility boilers creates unique maintenance and operational concerns related to these post-combustion NOx control technologies.

By introducing ammonia into a sulfur-containing flue gas stream, a unique set of chemical reactions occurs with the formation of ammonium, sulfate and bisulfate. The amount formed and the condensation temperature are dictated by the concentrations of ammonia and sulfur trioxide (SO_3) formed by the oxidation of sulfur dioxide (SO_2). Condensation temperatures range from 250•F to 500•F for the concentrations of interest in fossil fuel power generation.

In coal-fired boilers, the temperature window for ammonium sulfate and bisulfate condensation is typically realized in the air pre-heater. The result is sulfate condensation which fouls the air preheater and reduces thermal efficiency and increases pressure loss. Also of concern is increased ammonia content of the fly ash, which can have an economic impact due to reduced salability of the ash.

An SCR system can and should be designed to minimize the ammonia content of the fly ash and maintain high thermal efficiencies in the air preheater. Premature downtime of boilers with excessive deposition of sulfates on the air preheater can be avoided with prudent design of the NOx control system. Minimizing ammonia slip will also help to reduce the ammonia content of the fly ash, particularly for cold-side ESP and bay house arrangement.

This presentation discusses the design concepts of the SCR system, special design considerations for high sulfur fuels and maintenance issues for these units. Methods for minimizing the impact of ammonia on system operation and performance through SCR design are presented.